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Fatos Xhafa · Tomoya Enokido
Editors

Web, Artificial Intelligence and Network Applications

Proceedings of the Workshops of the 33rd International Conference on Advanced Information Networking and Applications (WAINA-2019)

Springer

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Welcome Message from AINA-2019 Steering Committee Co-chairs

Welcome to the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019). It is our great pleasure and honor to held AINA-2019 at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019. On behalf of the AINA Steering Committee and AINA-2019 Organizing Committee, we would like to express to all participants our cordial welcome and high respect.

AINA is an international forum, where scientists and researchers from academia and industry working in various scientific and technical areas of networking and distributed computing systems can demonstrate new ideas and solutions in distributed computing systems.

AINA was born in Asia, but it is now an international conference with high quality thanks to the great help and cooperation of many international friendly volunteers. AINA is a very open society and is always welcoming international volunteers from any country and any area in the world. In conjunction with AINA-2019 main conference, we have also 14 international workshops.

An international conference can be organized by support and great voluntary efforts of many people and organizations. Our main responsibility is to coordinate various tasks carried out with other willing and talented volunteers.

We would like to thank AINA-2019 General Co-chairs, PC Co-chairs, Workshop Co-chairs, Track Area Chairs, PC Members, and Workshop Organizers for their great efforts to make AINA-2019 a very successful event. We have special thanks to the Finance Chair and Web Administrator Co-chairs.

We would like to take opportunity to thank all members of the Organization Committee and Program Committee as well as all Reviewers for their hard work to make the reviews on time and authors for submitting the papers. We would like to thank Local Arrangement Team for the technical support and good local arrangement for the conference.

Finally, we would like to thank Matsue City, Shimane Prefecture, The Telecommunications Advancement Foundation (TAF), Japan, for their financial support.

We do hope that you will have a great time in Matsue, Japan.

Makoto Takizawa
Leonard Barolli
AINA Steering Committee Co-chairs

Welcome Message from AINA-2019 General Co-chairs

It is our great pleasure to welcome you all at the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019), which will be held at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

AINA International Conference is a forum for sharing ideas and research work in the emerging areas of information networking and their applications. The area of advanced networking has grown very rapidly, and the applications around it have experienced an explosive growth especially in the area of pervasive and mobile applications, sensor networks, ad hoc networks, vehicular networks, multimedia computing and social networking, semantic collaborative systems, as well as grid, P2P, IoT, and cloud computing. This advanced networking revolution is transforming the way people live, work, and interact with each other, and is impacting the way business, education, entertainment, and health care are operating. The papers included in the proceedings cover theory, design, and application of computer networks, distributed computing, and information systems.

Each year AINA receives a lot of paper submissions from all around the world. It has maintained high-quality accepted papers and is aspiring to be one of the main international conferences on the information networking in the world. In conjunction with AINA-2019 conference, there are 14 workshops, which also accepted good-quality papers.

An international conference of this size requires the support and help of many people. A lot of people have helped and worked hard to produce a successful AINA-2019 technical program and conference proceedings. First, we would like to thank all authors for submitting their papers, the session chairs, and distinguished keynote speakers. We are indebted to program area chairs, Program Committee Members and Reviewers, who carried out the most difficult work of carefully evaluating the submitted papers.

We would like to give our special thanks to Prof. Makoto Takizawa and Prof. Leonard Barolli, the Co-chairs of the Steering Committee for their strong encouragement, guidance, and insights, and for spending a lot of energy for conference organization and shaping the conference program. We would like to thank PC Co-chairs and Workshop Co-chairs of AINA-2019 for their great contribution to the

success of the conference. Our special thanks go to the Finance Chair and Web Administrator Co-chairs.

Finally, we would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. We do hope that you will have a great time in Matsue, Japan.

Tomoya Enokido
Farookh Hussain
Alireza Shahrabi
AINA-2019 General Co-chairs

Welcome Message from AINA-2019 Program Committee Co-chairs

Welcome to the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019), which will be held at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The purpose of AINA conference is to bring together researchers, developers, and industrial experts to share new ideas and recent research results in the emerging areas of information networking and their applications. The papers included in the proceedings cover all aspects of theory, design, and application of computer networks and distributed computing systems. Most of the papers deal with new trends in information networking, such as wireless sensor networks, ad hoc networks, cloud computing, peer-to-peer systems, grid computing, pervasive and ubiquitous systems, multimedia systems, security, multi-agent systems, IoT, and Web-based systems.

This edition AINA received many paper submissions from all over the world. Each submission was peer-reviewed by Program Committee members and invited external Reviewers. Finally, the Program Committee accepted 112 papers (about 25% acceptance ratio), which will be presented during the conference days. Unfortunately, many interesting and good papers could not be accepted in AINA-2019 due to the limited number of time slots allocated for presentations at the conference.

We are very proud and honored to have two distinguished keynote talks by Dr. Markus Aleksy, ABB AG, Germany, and Naohiro Hayashibara, Kyoto Sangyo University, Japan, who will present their recent work and will give new insights and ideas to the conference participants.

Organizing an international conference of this size is of course a team effort. Therefore, we gladly admit that we had the help of many very professional people. First of all, we would like to thank all the authors for their interesting contributions since they shape the program and make it interesting for the audience. Moreover, we would like to express our thankfulness to all program vice-chairs for their great efforts. Additionally, we would like to thank all Program Committee members and Reviewers who carried out the most important work to evaluate the submitted papers. We also thank the Workshop Co-chairs for organizing many excellent

workshops and symposiums, which enrich the conference and provide additional opportunities for discussions and future cooperations.

The great success of the AINA conference series would not be possible without the enormous commitment and support of the Steering Committee co-chairs Prof. Makoto Takizawa and Prof. Leonard Barolli. Therefore, we would like to thank them for their strong encouragement and guidance.

The general coordination of an event such as AINA conference requires a lot of coordination effort as well as many other activities related to the conference organization. Here, we thank the General Co-chairs for their great support and invaluable suggestions. We give special thanks to the Finance Chair and Web Administrator Co-chairs for their great efforts and efficient work to deal with many conference matters.

We hope you will enjoy the conference and readings and have a great time in Matsue, Japan.

Akimitsu Kanzaki
Flora Amato
Omar Hussain
AINA-2019 Program Committee Co-chairs

Welcome Message from AINA-2019 Workshops' Co-chairs

Welcome to AINA-2019 Workshops to be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019. The goal of AINA workshops is to provide a forum for international researchers and practitioners to exchange and share their new ideas, research results, and ongoing work on leading-edge topics in the different fields of information networks and their applications. Some of the accepted workshops deal with topics that open up perspectives beyond the ordinary, thus, enriching the topics usually addressed by the AINA conference.

For this edition, the following 14 symposiums and workshops will be held with AINA-2019.

1. The 15th International Symposium on Frontiers of Information Systems and Network Applications (FINA-2019)
2. The 15th International Workshop on Heterogeneous Wireless Networks (HWISE-2019)
3. The 12th International Symposium on Mining and Web (MAW-2019)
4. The 12th International Workshop on Bio and Intelligent Computing (BICom-2019)
5. The 12th International Workshop on Telecommunication Networking, Applications and Systems (TeNAS-2019)
6. The 10th International Workshop on Disaster and Emergency Information Network Systems (IWDENS-2019)
7. The 7th International Workshop on Collaborative Emerging Systems (COLLABES-2019)
8. The 6th International Workshop on Security Intricacies in Cyber-Physical Systems and Services (INTRICATE-SEC-2019)
9. The 5th International Workshop on Engineering Energy Efficient Internet Worked Smart seNsors (E3WSN-2019)
10. The 4th International Workshop on Innovative Technologies in Informatics and Networking (WITIN-2019)

11. The 4th International Workshop on Big Data Processing in Online Social Network (BOSON-2019)
12. The 2nd International Workshop on Internet of Everything and Machine Learning Applications (IOEMLA-2019)
13. The 1st International Workshop on Multi-Clouds and Mobile Edge Computing (M2EC-2019)
14. The 1st Workshop on Artificial Intelligence and Machine Learning (AIMAL-2019)

We would like to thank the community for their great response to AINA-2019 workshops. The excellent technical program of the workshops was the result of a professional work from Workshop Chairs, workshop Program Committees, Reviewers, and authors.

We would like to give our special thanks to Prof. Makoto Takizawa and Prof. Leonard Barolli, the Steering Committee Chairs of AINA International Conference, for their strong encouragement and guidance to organize the AINA-2019 workshops and symposiums. We would like to thank AINA-2019 General Co-chairs their advices to make possible organization of AINA-2019 workshops and symposiums. We are thankful to AINA-2019 Program Co-chairs for their support and help to prepare the technical program of AINA-2019 workshops and symposiums.

We wish all of you entertaining and rewarding experience in all workshops and AINA-2019 International Conference.

Hui-Huang Hsu
Omid Ameri Sianaki
Rubem Pereira
AINA-2019 Workshop Co-chairs

AINA-2019 Organizing Committee

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Kevin Bylykbashi	Fukuoka Institute of Technology, Japan

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Makoto Takizawa	Hosei University, Japan
Leonard Barolli	Fukuoka Institute of Technology, Japan

Welcome Message from FINA-2019 Symposium Co-chairs

Welcome to the 15th International Symposium on Frontiers of Information Systems and Network Applications (FINA-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The purpose of FINA symposium is to bring together developers and researchers to share ideas and research work in the emerging areas of information systems and their applications. Information systems and networks of today are going through a rapid evolution and are giving a great influence to our society. In addition, computing models are changing to new architecture like cloud computing, grid computing, and peer-to-peer (P2P) computing models. For this reason, it is significant to discuss how to design and realize high-performance computation models and network applications for distributed systems. The papers included in the proceedings cover novel theories, designs, and applications of information systems and network applications in advanced distributed system environments.

FINA-2019 contains high-quality research papers submitted by researchers from all over the world. Each submitted paper was peer-reviewed by Reviewers who are experts in the subject area of the paper. Based on the review results, the Program Committee accepted good-quality papers.

For organizing an international symposium, it is needed the support and help of many people. First, we would like to thank all authors for submitting their papers. We also appreciate the support from Program Committee members and Reviewers who carried out the most difficult work of carefully evaluating the submitted papers.

We would like to give our special thanks to Prof. Makoto Takizawa and Prof. Leonard Barolli, the Steering Committee Chairs of AINA, for their strong encouragement and guidance to organize the symposium. We would like to thank AINA-2019 General Co-chairs for their advices to make possible organization of FINA-2019. We also would like to thank AINA-2019 Workshop Co-chairs for their support.

We wish all of you entertaining and rewarding experience in FINA-2019 symposium and AINA-2019 conference.

Akimitsu Kanzaki
Flora Amato
Omar Hussain
FINA-2019 Symposium Co-chairs

FINA-2019 Organizing Committee

FINA-2019 Symposium Co-chairs

Akimitsu Kanzaki	Shimane University, Japan
Flora Amato	University of Naples Federico II, Italy
Omar Hussain	University of New South Wales, Australia

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Wenny Rahayu	La Trobe University, Australia
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Arjan Durresi	IUPUI, USA
Kin Fun Li	University of Victoria, Canada
Minoru Uehara	Toyo University, Japan
Akio Koyama	Yamagata University, Japan
Farookh Hussain	University of Technology, Sydney, Australia
Fang-Yie Leu	Tunghai University, Taiwan
Makoto Ikeda	Fukuoka Institute of Technology, Japan

Welcome Message from HWISE-2019 International Workshop Co-chairs

Welcome to the 15th International Workshop on Heterogeneous Wireless Networks (HWISE-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The goal of HWISE International Workshop is to bring together computer scientists, industrial engineers, and researchers to discuss and exchange experimental or theoretical results, novel designs, work-in-progress, experience, case studies, and trendsetting ideas in the area of heterogeneous wireless networks.

This international workshop collected research papers on the above research issues from all over the world. Papers collected in this international workshop were carefully reviewed, and according to the review results, the Program Committee members selected high-quality papers.

Many people have kindly helped us prepare and organize the HWISE-2019 workshop. First, we would like to thank the authors who submitted the papers and Reviewers who carefully evaluated the submitted papers. We would like to give our special thanks to Prof. Makoto Takizawa, as Steering Committee Co-chair of AINA, for his strong encouragement and guidance to organize the workshop. We would like to thank especially AINA-2019 General Co-chairs for their advices and support to make possible organization of HWISE-2019. We also, would like to thank Program Committee Co-chairs and Workshop Co-chairs for their help and directions.

We hope you will enjoy the conference and have a great time in Matsue, Japan.

Leonard Barolli
Arjan Durresi
HWISE-2019 International Workshop Co-chairs

HWISE-2019 Organizing Committee

Workshop Co-chairs

Leonard Barolli	Fukuoka Institute of Technology, Japan
Arjan Durresi	Indiana University Purdue University at Indianapolis, USA

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Mukul Goyal	University of Wisconsin Milwaukee, USA
Akio Koyama	Yamagata University, Japan
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Masakatsu Morii	Kobe University, Japan
Masakatsu Nishigaki	Shizuoka University, Japan
Vamsi Paruchuri	University of Central Arkansas, USA
Yoshitaka Shibata	Iwate Prefectural University, Japan
Kaoru Sugita	Fukuoka Institute of Technology, Japan
Fatos Xhafa	Polytechnic University of Catalonia, Spain
David Taniar	Monash University, Australia
Wenny Rahayu	La Trobe University, Australia
Eric Pardede	La Trobe University, Australia
Kin Fun Li	University of Victoria, Canada
Muhammad Younas	Oxford Brookes University, UK
Mimoza Durresi	European University of Tirana, Albania

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Donald Elmazi	Fukuoka Institute of Technology, Japan
Miralda Cuka	Fukuoka Institute of Technology, Japan
Kevin Bylykbashi	Fukuoka Institute of Technology, Japan

Welcome Message from MAW-2019 International Symposium Co-chairs

Welcome to the 12th International Symposium on Mining and Web (MAW-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

As the Web has become a major source of information, techniques and methodologies to extract quality information are of paramount importance for many Web applications and users. Data mining and knowledge discovery play key roles in many of today's prominent Web applications such as e-commerce and computer security. MAW-2019 symposium aims to bring together scientists, engineers, and practitioners to discuss, exchange ideas, and present their research on mining the Web.

After a thorough reviewing process conducted by the Program Committee, we selected high-quality papers for presentation at the symposium and publication in the proceedings.

We would like to express our sincere gratitude to the members of the Program Committee for their efforts and to AINA-2019 Organizing Committee for co-hosting MAW-2019. Most importantly, we thank all the authors for their submission and contribution to the symposium.

Finally, we would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. We do hope that you will have a great time in Matsue, Japan.

Kin Fun Li
Kosuke Takano
MAW-2019 Symposium Co-chairs

MAW-2019 Organizing Committee

Symposium Organizers

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Kosuke Takano	Kanagawa Institute of Technology, Japan

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Martine Wedlake	IBM, USA
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Jinmin Yang	Hunan University, China
Shengrui Wang	University of Sherbrooke, Canada

Welcome Message from BICom-2019 International Workshop Co-chairs

Welcome to the 12th International Workshop on Bio and Intelligent Computing (BICom-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The workshop is intended to facilitate exchange of ideas and collaborations between researchers form computer science, biology, medicine, mathematics, statistics, physics, intelligent computing, and such related sciences, to discuss various aspects of bio-computing, intelligent computing, and their applications.

This international workshop collected research papers on the above research issues from all over the world. Papers collected in this international workshop were carefully reviewed. According to the review results, the Program Committee members selected high-quality papers to be presented in this workshop.

Many people have kindly helped us to prepare and organize the BICom-2019 workshop. First, we would like to thank the authors who submitted high-quality papers and Reviewers who carefully evaluated the submitted papers. We would like to give our special thanks to Prof. Makoto Takizawa, as Steering Committee Co-chair of AINA-2019, for his strong encouragement and guidance to organize the workshop. We would like to thank especially AINA-2019 General Co-chairs, PC Co-chairs, and Workshop Co-chairs for their advices and support to make possible organization of BICom-2019.

Finally, we would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. We do hope that you will have a great time in Matsue, Japan.

Leonard Barolli
Arjan Durresi
BICom-2019 Co-chairs

BICom-2019 Organizing Committee

Workshop Co-chairs

Leonard Barolli	Fukuoka Institute of Technology, Japan
Arjan Durresi	Indiana University Purdue University at Indianapolis, USA

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Raj Jain	Washington University in St. Louis, USA

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Web Administrator Co-chairs

Kevin Bylykbashi	Fukuoka Institute of Technology, Japan
Miralda Cuka	Fukuoka Institute of Technology, Japan
Donald Elmazi	Fukuoka Institute of Technology, Japan

Welcome Message from TeNAS-2019 Workshop Organizers

We wish to extend a warm welcome to everyone attending the 13th International Workshop on Telecommunication Networking, Applications and Systems (TeNAS-2019), which is being held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) in Matsue, Japan. We would like to thank AINA-2019 Organizing Committee for providing us with this forum to bring together researchers and practitioners from across the world.

For the TeNAS-2019 workshop, we received submissions from various countries including academic and industrial contributions. Submissions were reviewed by two referees. The Program Committee, which consisted of researchers and practitioners from different fields in networking, security, applications, and distributed systems, selected good-quality papers to be presented in the workshop, covering a wide range of related topics.

Many people contributed to the organization of TeNAS-2019. We wish to thank the Program Committee members, the Steering Committee members, and the Reviewers for their great work.

Rubem Pereira
Jeu-Yih Jeng
TeNAS-2019 General Chairs
Teh-Sheng Huang
Shin-Hao Chang
TeNAS-2019 Program Committee Co-chairs

TeNAS-2019 Organizing Committee

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Timothy K. Shih	National Central University, Taiwan

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Rubem Pereira	Liverpool John Moores University, UK
Jeu-Yin Jeng	ChungHwa Telecom, Taiwan

Program Co-chairs

Teh-Sheng Huang	ChungHwa Telecom, Taiwan
Shih-Hao Chang	Tamkang, Taiwan

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Rob Hegarty	Manchester Metropolitan University, UK
Stefan Wallin	Data Ductus, Sweden

Teh-Lung Liu	NCHC, Taiwan
William Hurst	Liverpool John Moores University, UK
Hui Cheng	Liverpool John Moores University, UK
Gyu Myoung Lee	Liverpool John Moores University, UK

Welcome Message from IWDENS-2019 Workshop Organizers

Welcome to the 10th International Workshop on Disaster and Emergency Information Network Systems (IWDENS-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

This workshop serves as a forum for the exchange of information and ideas regarding with not only network design and implementation and application systems for large-scale national disasters such as earthquake, mountain explosion, Tsunami in addition to ordinal disasters, such as typhoon, rain flooding, and snowslide. Not only technological aspects by researchers but also actual experience by governmental officers or volunteers for disasters are also discussed.

A massive 9.1 magnitude earthquake hit over the northern Japan on March 11, 2011, and there were a number of papers submitted as the reports and researches of the earthquake. We hope that all participants of this workshop can share ideas and research works in the emerging areas of Disaster and Emergency Information Network and Systems.

Many people have kindly helped us to prepare and organize the IWDENS workshop. First of all, we would like to thank AINA-2019 Organization Committee for their support, guidance, and help for making the workshop. We would like to express our special thanks to all of IWDENS Program Committee members and Reviewers for organizing the workshop and reviewing the submitted papers, respectively. We also appreciate the member of recovery activities of the Great East Japan Earthquake and Tsunami for cooperating with this workshop.

Finally, we would like to give our special thanks to all members of Regional Disaster Information Network Research Institute in Iwate, Japan, for supporting and promoting IWDENS-2019.

Yoshitaka Shibata
Noriki Uchida
IWDENS-2019 Workshop Co-chairs

IWDENS-2019 Organizing Committee

Program Co-chairs

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Go Hirakawa	Network Applied Laboratory, Japan
Jun Sawamoto	Iwate Prefectural University, Japan
Kazuhiko Nakamura	National Institute of Information and Communication Technology (NICT), Japan
Tomoyuki Ishida	Fukuoka Institute of Technology, Japan

Welcome Message from COLLABES-2019 International Workshop Organizer

Welcome to the 7th International Workshop on Collaborative Emerging Systems (COLLABES-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The emergence of large-scale distributed computing paradigms, such as cloud computing and mobile computing systems, has opened up many opportunities for collaborative emerging systems (CES). Collaboration services are at the core of any information system, aiming to support collaboration among individuals, inter-teams, and intra-teams. While most CES have focused on using groupware systems (shared workspaces, videoconferencing, etc.) to support sharing and collaboration within one domain, the trend is to develop CES capable to support CES at large-scale integration. The objective of CES is thus to support efficient collaboration at large scale by addressing heterogeneity of resources, multi-domain nature, availability of resources, and system reliability.

The aim of COLLABES workshop is to gather innovative academic research results and experiences and best practices related to all aspects of collaborative emerging systems. I thank all of the authors and Reviewers for their support to the workshop, and we look forward to their contributions in forthcoming editions of the workshop.

Finally, I would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. I hope that workshop participants will have an enjoyable experience in Matsue, Japan.

Leonard Barolli
COLLABES-2019 Organizer

COLLABES-2019 Organizing Committee

Workshop Organizer

Leonard Barolli	Fukuoka Institute of Technology, Japan

Program Committee Members

Fatos Xhafa	Technical University of Catalonia, Spain
Keita Matsuo	Fukuoka Institute of Technology, Japan
Serguei Dobrinevski	Hypersoft, Germany
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Makoto Ikeda	Fukuoka Institute of Technology, Japan
Natalia Kryvinska	University of Vienna, Austria
Kin Fun Li	University of Victoria, Canada
Hiroaki Nishino	University of Oita, Japan
Makoto Takizawa	Hosei University, Japan
Tomoya Enokido	Rissho University, Japan
Markus Aleksy	ABB AG Corporate Research Center, Germany
Marek Ogiela	AGH University of Science and Technology, Poland
Akio Koyama	Yamagata University, Japan
Wenny Rahayu	La Trobe University, Australia
Lidia Ogiela	AGH University of Science and Technology, Poland
Nadeem Javaid	COMSATS University Islamabad, Pakistan
Hsing-Chung Chen	Asia University, Taiwan

Welcome Message from INTRICATE-SEC-2019 Workshop Chair

Welcome to the 6th International Workshop on Security Intricacies in Cyber-Physical Systems (INTRICATE-SEC-2019). The INTRICATE-SEC-2019 will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The INTRICATE-SEC workshop aims to bring together security practitioners and researchers to share ideas and research results in the emerging area of information security. It also provides a platform to discuss applications of security. The papers included in the proceedings cover novel theories, designs, and applications of information security to network applications as well as in advanced distributed system environments.

Organizing an international workshop requires the support and help of many people. I would like to thank all the authors for the paper submissions. I appreciate the support of the Program Committee members and Reviewers who carried out the most difficult work of carefully evaluating the submitted papers.

The special acknowledgments go to Prof. Makoto Takizawa and Prof. Leonard Barolli, the Steering Committee Chairs of AINA International Conference, for their strong encouragement and guidance in organizing the workshop. I would also like to thank General Co-chairs, Program Co-chairs, and Workshops Chairs for their support and help in preparing the technical program.

Finally, I would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. I do hope that you will have a great time in Matsue, Japan.

Anne Kayem
INTRICATE-SEC-2019 Workshop Chair

INTRICATE-SEC-2019 Organizing Committee

Workshop Chair

Anne Kayem	HPI, Germany

Program Committee Members

Stephen Wolthusen	Royal Holloway, University of London, UK and Norwegian University of Science and Technology, Norway
Christoph Meinel	HPI, Germany
Stephen Marsh	University of Ontario Institute of Technology, Canada
Cristina Alcaraz	University of Malaga, Spain
Zeyar Aung	Masdar Institute of Science and Technology, UAE
Dieter Hutter	DFKI GmbH, Germany
Zekeriya Erkin	Delft University of Technology, The Netherlands
Ingo Stengel	University of Applied Sciences Karlsruhe, Germany
George Yee	Carleton University, Canada

Welcome Message from E3WSN-2019 International Workshop Co-chairs

Welcome to the 5th on Engineering Energy Efficient Internet Worked Smart seNsor (E3WSN-2019), which is held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

This workshop aims at bringing together academics and practitioners from different areas (such as software engineering, system engineering, energy efficiency, and embedded systems) to promote design, validation, and implementation of energy-efficient inter-networked smart sensors. The papers included in the proceedings cover novel languages, designs, simulation, and applications of inter-networked smart sensors.

E3WSN-2019 contains high-quality research papers submitted by researchers from all over the world. Each submitted paper was peer-reviewed by Reviewers who are experts in the subject area of the paper. Based on the review results, the Program Committee accepted good-quality papers.

For organizing an international workshop, the support and help of many people are needed. First, we would like to thank all authors for submitting their papers. We also appreciate the support from Program Committee members and Reviewers who carried out the most difficult work of carefully evaluating the submitted papers.

The E3WSN organization team would like to give its special thanks to the Steering Committee Chairs, General Co-chairs, Program Co-chairs, and Workshop Organizers for their support to organize the workshop.

Leonardo Mostarda
Jonathan Loo
E3WSN-2019 Co-chairs

E3WSN-2019 Organizing Committee

Workshop Co-chairs

Leonardo Mostarda	Camerino University, Italy
Jonathan Loo	University of West London, UK

Program Committee Members

Dajana Cassioli	L'Aquila University, Italy
Mauro Caporuscio	Linnaeus University, Vaxjo, Sweden
Changyu Dong	New Castle University, UK
Naranker Dulay	Imperial College London, UK
Enver Ever	Middle East Technical University, Northern Cyprus Campus
Sandu Florin	Transilvania University of Brasov, Romania
Orhan Gemikonakli	Middlesex University, UK
Altan Kocyigit	Middle East Technical University, Turkey
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Henry Muccini	L'Aquila University, Italy
Alfredo Navarra	University of Perugia, Italy
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Purav Shah	Middlesex University London, UK
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Rosario Culmone	Camerino University, Italy
Ramona Trestian	Middlesex University, UK
Adnan Yazici	Middle East Technical University, Turkey
Krishna Doddapaneni	Altiux Innovations, Mountain View, California, USA
Fadi Al-Turjman	Middle East Technical University, Northern Cyprus Campus

Welcome Message from WITIN-2019 International Workshop Organizers

Information and networking technologies have been a major driving force for the advances of human society for decades. This 4th edition of International Workshop on Innovative Technologies in Informatics and Networking (WITIN-2019) aims to attract innovative attempts in the related fields. This workshop will provide a platform for researchers and practitioners to meet and exchange their ideas.

WITIN-2019 will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019. We accepted very good-quality papers for WITIN-2019 after a rigorous selection process. We hope all of you will enjoy the workshop and find it a great opportunity to discuss research works.

Many people contributed to the CFP and paper review of WITIN-2019. We wish to thank the Program Committee members for their excellent effort in screening and selecting the papers. We would like to express our gratitude to Prof. Makoto Takizawa and Prof. Leonard Barolli, the Steering Committee Co-chairs of AINA International Conference, for their encouragement and guidance. We are very thankful to General Co-chairs, PC Co-chairs, and Workshop Co-chairs of AINA-2019, for their great organization of this conference. Last but not least, we would like to thank and congratulate all the authors for their support to the workshop.

Hui-Huang Hsu
Yi-Jen Su
WITIN-2019 Workshop Co-chairs

WITIN-2019 Organizing Committee

Workshop Co-chairs

Hui-Huang Hsu	Tamkang University, Taiwan
Yi-Jen Su	Shu-Te University, Taiwan

Program Committee Members

Chuan-Yu Chang	National Yunlin University of Science and Technology, Taiwan
Chuan-Wang Chang	Kun Shan University, Taiwan
Chao-Ho Chen	National Kaohsiung University of Science and Technology, Taiwan
Chia-Yen Chen	The University of Auckland, New Zealand
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Wu-Chih Hu	National Penghu University of Science and Technology, Taiwan
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Chien-Chuan Ko	National Chiayi University, Taiwan
Lung-Jen Wang	National Pingtung University, Taiwan
Chien-Chung Wu	Southern Taiwan University of Science and Technology, Taiwan

Welcome Message from BOSON-2019 International Workshop Chair

Welcome to the 4th International Workshop on Big Data Processing in Online Social Network (BOSON-2019), which is held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019), a at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The purpose of BOSON workshop is to bring together scientists, engineers, and students for sharing experiences, ideas, and research results about big data processing and online social networks.

This workshop provides an international forum for researchers and participants. It aims to share and exchange experiences, discuss challenges, and present original ideas in all aspects related to the big data processing and online social network applications design and development. In particular, we have encouraged innovative contributions about: big data processing, online social network, distributed computing applications, ubiquitous positioning methods, topologies for distributed computing, modeling and simulation of big data, modeling and simulation of distributed systems, distributed knowledge management, systems and algorithms for social search, collaborative platforms, distributed computing for smart cities, distributed computing for e-health, smart grid modeling; quality evaluation of distributed services, semantic technologies, modeling social networks and behavior, management of social network data, information propagation in social networks, data mining and machine learning in social systems, sentiment analysis on OSNs, privacy and security in social systems, trust and reputations in social systems.

For organizing an international workshop, the support and help of many people are needed. First, I would like to thank the Organizing Committee of AINA-2019 International Conference for giving us the opportunity to organize the workshop. Second, I would like to thank our Program Committee Members and Reviewers who carried out the most difficult work of carefully evaluating the submitted papers. I also would like to thank all authors for submitting their research works and for their participation. Moreover, I would like to thank the Local Arrangement Chairs of AINA-2019 conference.

I would like to give my special thanks to Prof. Leonard Barolli and Prof. Makoto Takizawa, the Steering Committee Chairs of AINA, for their strong encouragement

and guidance to organize the workshop. I would like to thank AINA-2019 General Co-chairs, PC Co-chairs, and Workshop Co-chairs for their support and help to prepare the technical program.

I hope you will enjoy BOSON workshop and AINA International Conference, find this a productive opportunity for sharing experiences, ideas, and research results with many researchers, and have a great time in Matsue, Japan.

Flora Amato
BOSON-2019 Workshop Chair

BOSON-2019 Organizing Committee

Workshop Chair

Flora Amato	University of Naples "Federico II," Italy

Workshop Program Committee Co-chairs

Francesco Moscato	University of Campania "Luigi Vanvitelli," Italy
Vincenzo Moscato	University of Naples "Federico II," Italy

Program Committee Members

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Nicola Mazzocca	University of Naples "Federico II," Italy
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Porfirio Tramontana	University of Naples "Federico II," Italy
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Luigi Gallo	Institute for High Performance Computing and Networking (ICAR), Italy
Aniello Minutolo	Institute for High Performance Computing and Networking (ICAR), Italy
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Giovanni Cozzolino	University of Naples "Federico II," Italy
Giovanna Sannino	Institute for High Performance Computing and Networking (ICAR)
Fiammetta Marulli	Institute for High Performance Computing and Networking (ICAR)
Marco Pota	Institute for High Performance Computing and Networking (ICAR), Italy
Giuseppe Caggianese	Institute of High Performance Computing and Networking (ICAR), Italy

Francesco Mercaldo	Consiglio Nazionale delle Ricerche, Italy
Alessandro Maisto	University of Salerno, Italy
Serena Pelosi	University of Salerno, Italy
Raffaele Guarasci	University of Salerno, Italy

Welcome Message from IOEMLA-2019 International Workshop Co-chair

Welcome to the 2nd International Workshop on Internet of Everything and Machine Learning Applications (IOEMLA-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The workshop is intended to facilitate exchange of ideas between researchers and presents the latest developments and research in the areas of IoE and machine learning in cross-disciplinary domains such as data science, IoT, industrial IoE, and computer and intelligent networks.

This international workshop collected research papers written by some established international researchers. These papers went through multiple review cycles and were handpicked based on their quality, clarity, and relevance to the theme of this workshop.

Many people have kindly helped us to prepare and organize the IOEMLA-2019 workshop. Firstly, I would like to thank the authors who submitted high-quality papers. I also would like to acknowledge the valuable comments of the Reviewers, which have enabled us to select these papers out of the so many submissions we received.

I would like to give our special thanks to Prof. Leonard Barolli and Prof. Makoto Takizawa, as Steering Committee Co-chairs of AINA International Conference, for their strong encouragement and guidance to organize the workshop. I also would like to thank AINA-2019 General Co-chairs, PC Co-chairs, and Workshop Co-chairs for their continuous support throughout the entire process of the IOEMLA-2019 workshop. I do hope that you will have a wonderful time in Matsue, Japan.

Omid Ameri Sianaki
IOEMLA-2019 Workshop Co-chair

IOEMLA-2019 Organizing Committee

Workshop Co-chair

Omid Ameri Sianaki	Victoria University, Australia

Program Committee Members

Elizabeth Chang	UNSW Canberra, Australia
Vidyasagar Potdar	Curtin University, Australia
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Mohammadreza Hoseinfarahabady	The University of Sydney, Australia
Israel Casas Lopez	Victoria University, Australia
Belal Alsinglawi	Western Sydney University, Australia

Welcome Message from M2EC-2019 Workshop Organizers

Welcome to the 1st International Workshop on Multi-Clouds and Mobile Edge Computing (M2EC-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

Today, a large number of enterprises and individuals rely on services offered by clouds to meet their computational and storage demands. However, in general, no single cloud provider is able to provide all the features a user may need in a cost-efficient way, while satisfying the user's security and performance requirements. Even the most dominant cloud providers have limited geographical presence. Cloud federation enables end users to integrate segregated resources from different cloud providers. The use of multi-clouds offers more freedom to the cloud users and increases the granularity of choices in the application deployment. Growing interest in multi-clouds pushes the need to investigate a large number of under-explored research topics, ranging from multi-cloud resource provisioning, application deployments, automated configurations, federated networking, adaptations, security and privacy. Moreover, with the growing need of real-time data analytics and critical event handling by many modern applications, such as in the Internet of Things (IoT), it is evident that the centralized computation and storage model offered by cloud computing are not suitable for such applications, due to high end-to-end latencies. Mobile edge computing (MEC) enables a computing and storage infrastructure provisioned closely to the end users at the edge of a cellular network. Combining MEC in multi-cloud infrastructures can help to combat latency challenges imposed by the cloudcentric architectures.

The intent of this workshop is to bring together people from research and industry, in order to provide a discussion forum for state-of-the-art topics related to cloud, multi-cloud, and mobile edge computing technology, networks, and applications.

Many people have kindly helped us to prepare and organize the M2EC-2019 workshop. First of all, we would like to thank AINA-2019 Organization Committee for their support, guidance, and help for making the workshop. We would like to

express our special thanks to M2EC-2019 Program Committee members and Reviewers.

Finally, we would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. We do hope that you will have a great time in Matsue, Japan.

Dimitris Apostolou
Thomas Dreibholz
Feroz Zahid
M2EC-2019 Workshop General Co-chairs

M2EC-2019 Organizing Committee

General Co-chairs

Dimitris Apostolou	Institute of Communication and Computer Systems, Greece
Thomas Dreibholz	Simula@OsloMet – Simula Metropolitan Centre for Digital Engineering, Norway
Feroz Zahid	Simula Research Laboratory, Norway

Publicity Chairs

Xing Zhou	Hainan University, China
Paweł Skrzypek	7bulls.com, Poland

Program Committee Members

Xuejun Cai	Ericsson, Sweden
Jörg Domaschka	Ulm University, Germany
Ahmed Elmokashfi	Simula@OsloMet – Simula Metropolitan Centre for Digital Engineering, Norway
Ernst Gunnar Gran	NTNU Gjøvik, Norway
Ralph Holz	University of Sydney, Australia
Geir Horn	University of Oslo, Norway
Quentin Jacquemart	CRNS, France
Kyriakos Kritikos	FORTH, Institute of Computer Science, Greece
Xiaoyi Lu	The Ohio State University, USA
Sabita Maharjan	Simula@OsloMet – Simula Metropolitan Centre for Digital Engineering, Norway
Somnath Mazumdar	Simula Research Laboratory, Norway
Omer Rana	Cardiff University, UK
Samuel Rodrigo-Mocholí	Graphcore, Norway
Jesús Escudero-Sahuquillo	Universidad de Castilla-La Mancha, Spain
Paresh Saxena	BITS Pilani University, India
Jawwad Shamsi	FAST NUCES, Pakistan
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Salman Taherizadeh	Jozef Stefan Institute, Slovenia
Amir Taherkordi	University of Oslo, Norway
Yiannis Verginadis	Institute of Communication and Computer Systems, Greece
Øyvind Ytrehus	University of Bergen, Norway

Welcome Message from AIMAL-2019 Workshop Chair

Welcome to the 1st International Workshop on Artificial Intelligence and Machine Learning (AIMAL-2019), which will be held in conjunction with the 33rd International Conference on Advanced Information Networking and Applications (AINA-2019) at Kunibiki Messe, Matsue, Japan, from March 27–29, 2019.

The scope of the AIMAL is to provide a platform for sharing the work from the domains of smart grid (SG), cloud computing (CC), and big data (BD). This platform enables the collaboration of the researchers around the globe via sharing their work in the aforementioned domains. SG acts as the backbone platform for the integration and development of new tools and technologies using the CC and BD methodologies. It covers the supply-side and demand-side electricity management through bidirectional communication mechanisms. Supply side relies on the management of electricity generation, transmission, and distribution, whereas demand side focuses on the consumers' energy consumption management. SG also describes the demand response techniques in order to facilitate the consumers in terms of minimizing their electricity bills and energy consumption by maintaining the user preferences using the CC and BD technologies.

The goal of this workshop is to collect novel academic research work including its simulation and best experimental results regarding all perspectives of the SG, CC, and BD applications.

Many people supported and encouraged us to prepare and organize the AIMAL-2019 workshop. We would like to thank AINA-2019 Organization Committee for their guidance and help. We would like to express our special thanks to AIMAL-2019 Program Committee members and Reviewers.

Finally, we would like to thank the Local Arrangement Team for the support and good local arrangement for the conference. We do hope that you will have a great time in Matsue, Japan.

Nadeem Javaid
AIMAL-2019 Workshop Chair

AIMAL-2019 Organizing Committee

Workshop Chair

Nadeem Javaid	COMSATS University Islamabad, Pakistan

Program Committee Members

Kamran Munir	University of the West England, UK
Safdar Hussain Bouk	DGIST, Korea
Muhammad Imran	King Saud University, Saudi Arabia
Syed Hassan Ahmed	Georgia Southern University, USA
Hina Nasir	Air University Islamabad, Pakistan
Sakeena Javaid	COMSATS University Islamabad, Pakistan
Rasool Bakhsh	COMSATS University Islamabad, Pakistan
Asif Khan	COMSATS University Islamabad, Pakistan
Adia Khalid	COMSATS University Islamabad, Pakistan
Sana Mujeeb	COMSATS University Islamabad, Pakistan

AINA-2019 Keynote Talks

Utilizing Wireless Communication to Enable New Types of Industrial Applications

Markus Aleksy

ABB AG Corporate Research Center, Ladenburg, Germany

Abstract. The recent progress in the development of wireless communication technologies enables new types of industrial applications. Traditional industrial systems usually rely on wired communication technologies to connect sensors and actuators. However, these type of communication needs to be replaced by wireless technologies in future to address new developments, such as mixed reality applications, automated guided vehicles, moving robots and drones or achieving higher flexibility required by increasing demand for highly customized products and adaptable production facilities. In this talk, we will address and discuss representative use cases and concepts focusing on the usage of wireless technologies in an industrial setting. Moreover, we will present the related challenges and requirements of communication networks in such environments and discuss the applicability of 5th generation wireless communication systems.

Lévy Walk on Graphs: Message Dissemination and Uninformed Search

Naohiro Hayashibara

Kyoto Sangyo University, Kyoto, Japan

Abstract. Random walks play an important role in computer science, spreading a wide range of topics in theory and practice, including networking, distributed systems, and optimization. Particularly, Lévy walk, a family of random walks, has attracted attention in recent years in the context of mobile ad-hoc networks, delay-tolerant networks, opportunistic communication, and global optimization problems. It is also used as a model of various things not only in informatics but also in biology and environmental science. Lévy walk is a mathematical fractal which is characterized by long segments followed by shorter hops in random directions. More precisely, the step distance obeys the power law distribution. The pattern has been found by Paul Lévy, but the similar pattern has also been evolved as a naturally selected strategy that gives animals and insects an edge in the search for sparse targets to survive. In fact, this movement pattern has been observed in the molecular machinery operating in cells, bacteria, the behavior of honeybees, mussels, mud snails, wandering albatross and shearwaters. In the area of computer science, it is most likely to be used as the mobility model in mobile ad-hoc networks because of the statistical similarity of human mobility. Most of the research work, however, assumes a continuous plane and hardly any results on graphs are available. The goal of this keynote is introducing Lévy walk and its variants and presenting the challenge on Geometric graphs, especially Unit disk graphs, regarding message dissemination and uninformed search by using Lévy walk. The results on both message dissemination and uninformed search show that Lévy walk is quite efficient compared to random walks because of its ballistic trajectory. They also clarify the relationship between the efficiency of message dissemination and uninformed search, and the average degree/the diameter of the graphs.

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